

Ryohei Nakatsu  
Matthias Rauterberg  
Paolo Ciancarini  
*Editors*

# Handbook of Digital Games and Entertainment Technologies



SpringerReference

---

Ryohei Nakatsu • Matthias Rauterberg  
Paolo Ciancarini  
Editors

# Handbook of Digital Games and Entertainment Technologies

Volume 1

With 373 Figures and 36 Tables

 Springer Reference

*Editors*

Ryohei Nakatsu  
Design School  
Kyoto University  
Kyoto, Japan

Matthias Rauterberg  
Industrial Design  
Eindhoven University of Technology  
Eindhoven, The Netherlands

Paolo Ciancarini  
Dipto. Scienze dell'Informazione  
Università di Bologna  
Bologna, Italy

ISBN 978-981-4560-49-8                      ISBN 978-981-4560-50-4 (eBook)  
ISBN 978-981-4560-51-1 (print and electronic bundle)  
DOI 10.1007/978-981-4560-50-4

Library of Congress Control Number: 2016940980

© Springer Science+Business Media Singapore 2017

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made.

Printed on acid-free paper

This Springer imprint is published by Springer Nature  
The registered company is Springer Science+Business Media Singapore Pte Ltd.

---

## Preface

We are very proud of presenting to the reader this Springer *Handbook of Digital Games and Entertainment Technologies*.

The Handbook covers all aspects of designing and building the most advanced interactive systems and devices for playing and entertaining, such as human-machine interfaces, networks and robots, artificial intelligence, and interactive television, and includes interdisciplinary studies on serious games, digital art, edutainment, entertainment ethics and sociology, and many more. The scope of each part spans from basic theories to enabling technologies, and from advanced applications to psychological and sociological reflections on those.

Entertainment is an essential part of our everyday activities. When we are children we play with our friends and listen to stories told by our relatives: these experiences are the basis of our ability to communicate, discuss, and negotiate with others. Johan Huizinga showed in his book *Homo Ludens* that playing is the basis of our culture. In the course of the human history, however, somehow entertainment has been thought as a marginal activity of lesser importance with respect to other activities such as education, work, medicine, etc.

Thanks to the development of digital information and communication technologies (ICT), recently a plethora of new and interactive entertainment systems and products have emerged: from lean-back consumption to lean-forward interaction. Not only the younger generations but also more mature generations enjoy playing video games, communicating via social networks, and using new enhanced entertainment media like interactive television or immersive virtual reality systems. These new systems and products are blurring the distinction between work and play just as the psychologist Mihaly Csikszentmihalyi indicated in his “Flow Theory.”

The entertainment market is huge; the companies offering products in the areas of playing consoles, smart toys, online games, digital music, interactive TVs, movies, robots, etc., are economically very relevant. However, until recently entertainment was not considered as a major research topic in academia. In the first decade of the current twenty-first century, some pioneering researchers including us working in the area of entertainment met several times in specific conferences and agreed to define a new research area called “entertainment computing.” In this new area, we wanted to get together various types of interdisciplinary research. We asked the International Federation on Information Processing (IFIP) to setup a new technical committee

focusing on entertainment computing. In 2002, our proposal was accepted and we formed a new group called Specialist Group on Entertainment Computing that in 2006 was upgraded to Technical Committee on Entertainment Computing (IFIP TC14). Members of TC14 have been working in various areas of entertainment computing and have been promoting academic activities in this area.

Today, the design of digital games exploiting entertainment technologies has been recognized as an important and attractive topic in academic research. There are many people both in academia and industry who want to know the most recent topics and developments. Therefore we accepted the invitation by Springer to edit this Handbook. We hope that this work will contribute to a prospering development of entertainment computing both in academia and industry.

The aim of this Handbook is to serve as a key reference work as it provides the readers with a holistic picture of this interdisciplinary field covering technical issues, aesthetic/design theories, and sociological investigations. The Handbook consists of invited contributions from top class scholars and researchers from several topic areas. Each author was assigned the task to recall the foundations of a specific subject in the field of entertainment computing, to survey the current state of the art in the same field, and finally to sketch the most advanced entertainment applications related to that field.

The parts and their editors are the following:

1. Artificial Intelligence and Games (part editor Paolo Ciancarini): Artificial intelligence is a fundamental enabling technology for improving the playing experience in several types of games. This part includes four chapters dealing with algorithms and technologies for solving games, especially based on machine learning from large sets of playing data.
2. Brain-Computer Interfaces and Games (part editor Anton Nijholt): The direct exploitation of the brain activities of players is a radically new way to interact with entertainment products. This part includes six chapters describing how special devices allow to play in novel ways and how they influence the design of new videogames.
3. Entertainment Games (part editor Junichi Hoshino): Digital games are the core of entertainment computing. This part includes four chapters on different types of videogames exploiting a variety of entertainment computing technologies. Especially a survey on digital game industry would give readers the latest and deep insight into this fast moving area.
4. Interactive Storytelling (part editors Marc Cavazza and Michael Young): Storytelling is a very ancient activity; interactive storytelling is based on software which supports a narrative whose storyline is not predetermined. Interactive storytelling fulfills an old dream: the ability of the listener to “enter” the story she is told. This part includes five chapters which display a very interdisciplinary panorama on this subject.
5. Networking in Games (part editor Marco Rocchetti): The global availability of the Internet and the widespread diffusion of powerful smartphones and personal

computers allow millions of people to play anytime everywhere, alone or in very large parties. Entertainment systems need advanced network technologies which connect devices with very different capabilities. This part includes five chapters on the main issues in networking for entertainment.

6. Serious Games (part editor Alessandro De Gloria): Serious games are one of the most promising areas in bridging the gap between joyful play and professional use through gamification. This part includes three chapters on serious gaming regarding science, technology, engineering, and mathematics (STEM); corporate identity; and ethics, privacy, and trust.
7. Art and Entertainment (part editors Ryohei Nakatsu and Naoko Tosa): Entertainment computing is a discipline whose aim is to combine technology with other areas such as art, culture, etc. Digital arts are novel forms of expression that we are learning to appreciate. This part includes seven chapters showing various examples on how entertainment computing handle art and culture.
8. Edutainment (part editor Wolfgang Mueller): The combination of edutainment and entertainment technologies – sometimes called “gamification” – offers new possibilities to educators and learners. This part includes two chapters.
9. Entertainment Robots (part editors Hooman Samani and Elham Saadatian): Robots are just starting to coexist with humans in several fields. Playful robotic devices offer new challenges in human-machine interactions and enable new kinds of user experiences that need to be studied with special care. This part includes four chapters.
10. Interactive Television and Online Experiences (part editor Marianna Obrist): Digital technologies enable new ways of interacting with old media: interactive TV is one major example, where the viewer is allowed to participate in the TV experience. This part includes five chapters.
11. Social and Ethical Issues (part editor Matthias Rauterberg): Because entertainment products have not only a technical and economical impact but also an enormous societal impact, this part addresses all related topics. This part includes six chapters on social and ethical aspects regarding positive and negative effects, in particular addiction, emerging media technology, and unconscious emotions.

This Handbook is a work in progress (a living reference work in Springer terms). This means that the authors and the part editors are allowed to update the online version of the papers even before the next edition of the Handbook. We are already planning a new edition, to include the new developments and topics that the exciting field of entertainment computing will study in the next future. Therefore, we will invite additional chapters from recognized experts in such fields.

The editors wish to thank all those who contributed to this Handbook, especially all part editors who have collected valuable chapter papers and reviewed them to guarantee the high quality of this Handbook.

This Handbook can be cited as follows:

Ryohei Nakatsu, Matthias Rauterberg, and Paolo Ciancarini (eds.), *Handbook of Digital Games and Entertainment Technologies*, Springer Singapore, 2016.  
DOI [10.1007/978-981-4560-52-8](https://doi.org/10.1007/978-981-4560-52-8). ISBN (online) 978-981-4560-50-4

Ryohei Nakatsu  
Matthias Rauterberg  
Paolo Ciancarini

---

# Contents

## Volume 1

<b>Part I AI and Games</b> .....	<b>1</b>
<b>1 Game Solvers</b> .....	<b>3</b>
Akihiro Kishimoto and Martin Mueller	
<b>2 General Game Playing</b> .....	<b>23</b>
Yngvi Björnsson and Stephan Schiffel	
<b>3 Monte-Carlo Tree Search in Board Games</b> .....	<b>47</b>
Mark H. M. Winands	
<b>4 Physics Simulation Games</b> .....	<b>77</b>
Jochen Renz and Xiaoyu Ge	
<b>Part II BCI and Games</b> .....	<b>97</b>
<b>5 Action Games, Motor Imagery, and Control Strategies: Toward a Multi-button Controller</b> .....	<b>99</b>
Damien Coyle, Jacqueline Stow, Karl. A. McCreddie, Chen Li, Jhonatan Garcia, Jacinta McElligott, and Aine Carroll	
<b>6 Brain-Computer Interface Games: Towards a Framework</b> .....	<b>133</b>
Hayrettin Gurkok, Anton Nijholt, and Mannes Poel	
<b>7 Brain-Computer Interfacing and Virtual Reality</b> .....	<b>151</b>
Doron Friedman	
<b>8 Games for BCI Skill Learning</b> .....	<b>173</b>
Reinhold Scherer, Gernot Müller-Putz, Elisabeth V. C. Friedrich, Viktoria Pammer-Schindler, Karin Wilding, Stephan Keller, and Johanna Pirker	



<b>9</b>	<b>Towards Serious Games for Improved BCI</b> .....	<b>197</b>
	Brent J. Lance, Jon Touryan, Yu-Kai Wang, Shao-Wei Lu, Chun-Hsiang Chuang, Peter Khooshabeh, Paul Sajda, Amar Marathe, Tzyy-Ping Jung, Chin-Teng Lin, and Kaleb McDowell	
<b>10</b>	<b>User-Centered BCI Videogame Design</b> .....	<b>225</b>
	Emilie Loup-Escande, Fabien Lotte, Guillaume Loup, and Anatole Lécuyer	
<b>Part III</b>	<b>Entertainment Games</b> .....	<b>251</b>
<b>11</b>	<b>Current Status of Applying Artificial Intelligence in Digital Games</b> .....	<b>253</b>
	Youichiro Miyake	
<b>12</b>	<b>Hand Gesture Interface for Entertainment Games</b> .....	<b>293</b>
	Kiyoshi Hoshino	
<b>13</b>	<b>Intelligent Character Technologies for Entertainment Games</b> ....	<b>313</b>
	Hiroshi Mori	
<b>14</b>	<b>Real-World Game Platform for Lifelong Learning Society</b> .....	<b>331</b>
	Junichi Hoshino	
<b>Part IV</b>	<b>Interactive Storytelling</b> .....	<b>347</b>
<b>15</b>	<b>Discourse and Camera Control in Interactive Narratives</b> .....	<b>349</b>
	Arnav Jhala	
<b>16</b>	<b>Interactive Storytelling Paradigms and Representations: A Humanities-Based Perspective</b> .....	<b>361</b>
	Hartmut Koenitz	
<b>17</b>	<b>Introduction to Interactive Storytelling</b> .....	<b>377</b>
	Marc Cavazza and R. Michael Young	
<b>18</b>	<b>Planning Technologies for Interactive Storytelling</b> .....	<b>393</b>
	Julie Porteous	
<b>19</b>	<b>User Interaction for Interactive Storytelling</b> .....	<b>415</b>
	Marc Cavazza and Fred Charles	
<b>Part V</b>	<b>Networking in Games</b> .....	<b>429</b>
<b>20</b>	<b>Commodity Video Game Technology in Teletherapy</b> .....	<b>431</b>
	Gary Ushaw, Richard Davison, and Graham Morgan	
<b>21</b>	<b>Network Support for Mobile Gaming</b> .....	<b>459</b>
	Armir Bujari, Marco Furini, and Claudio E. Palazzi	

<b>22</b>	<b>Opportunistic Networking for Games and Entertainment</b> . . . . .	<b>481</b>
	Dario Maggiorini, Laura Anna Ripamonti, and Christian Quadri	
<b>23</b>	<b>QoE and Latency Issues in Networked Games</b> . . . . .	<b>509</b>
	Jose Saldana and Mirko Suznjevic	
<b>24</b>	<b>Video Gaming on Ad Hoc Networks: Challenges and Solutions</b> . . . . .	<b>545</b>
	Nadjib Achir and Khaled Boussetta	
<b>Part VI Serious Games</b> . . . . .		<b>569</b>
<b>25</b>	<b>A Tangible Serious Game Approach to Science, Technology, Engineering, and Mathematics (STEM) Education</b> . . . . .	<b>571</b>
	Riccardo Berta, Francesco Bellotti, Erik van der Spek, and Thomas Winkler	
<b>26</b>	<b>Serious Games and Their Application in Creating Corporate Identity</b> . . . . .	<b>593</b>
	Magdalena Bielenia-Grajewska	
<b>27</b>	<b>Ethics, Privacy, and Trust in Serious Games</b> . . . . .	<b>611</b>
	Rod McCall and Lynne Baillie	

**Volume 2**

<b>Part VII Art and Entertainment</b> . . . . .		<b>641</b>
<b>28</b>	<b>Computer Music Languages and Systems: The Synergy Between Technology and Creativity</b> . . . . .	<b>643</b>
	Hiroki Nishino and Ryohei Nakatsu	
<b>29</b>	<b>Häusliches Glück: A Case Study on Deception in a Mixed Reality Environment</b> . . . . .	<b>693</b>
	Alex Davies and Jeffrey Koh	
<b>30</b>	<b>Entertainment, Culture, and Media Art</b> . . . . .	<b>725</b>
	Ryohei Nakatsu, Naoko Tosa, Matthias Rauterberg, and Wang Xuan	
<b>31</b>	<b>Games of Chance: Explorations into Our Animal Selves</b> . . . . .	<b>777</b>
	Siddharth Ramakrishnan and Victoria Vesna	
<b>32</b>	<b>Interface-Centric Art Games</b> . . . . .	<b>805</b>
	Christa Sommerer, Ulrich Brandstätter, and Laurent Mignonneau	
<b>33</b>	<b>Love and Sex with Robots</b> . . . . .	<b>833</b>
	Adrian David Cheok, David Levy, Kasun Karunanayaka, and Yukihiko Morisawa	

---

<b>34 Media, Art, and Society: Interface of the Digital Image, Aesthetics, and Culture</b> .....	859
Alistair D. Swale	
<b>Part VIII Edutainment</b> .....	<b>881</b>
<b>35 Edutainment in Sport and Health</b> .....	883
Josef Wiemeyer and Lars L. Tremper	
<b>36 Gamification</b> .....	909
Alke Martens and Wolfgang Müller	
<b>Part IX Entertainment Robots</b> .....	<b>933</b>
<b>37 Challenges for Robots Acting on a Stage</b> .....	935
Mayumi Bono, Perla Maiolino, Augustin Lefebvre, Fulvio Mastrogiovanni, and Hiroshi Ishiguro	
<b>38 Design and Development of Playful Robotic Interfaces for Affective Telepresence</b> .....	979
Elham Saadatian, Hooman Samani, and Ryohei Nakatsu	
<b>39 Enrobotment: Toy Robots in the Developing Brain</b> .....	1011
Irina Giannopulu	
<b>40 Manzai Robots: Entertainment Robots as Passive Media Based on Autocreated Manzai Scripts from Web News Articles</b> .....	1041
Tomohiro Umetani, Akiyo Nadamoto, and Tatsuya Kitamura	
<b>Part X Interactive TV and Online Video Experiences</b> .....	<b>1069</b>
<b>41 Digital Interactive Television and the Older Generation</b> .....	1071
Mark Rice and Mark Springett	
<b>42 Interactive Digital Narratives for iTV and Online Video</b> .....	1097
Hartmut Koenitz and Noam Knoller	
<b>43 Place and ITV: Playful Design Strategies Towards Place-Oriented ITV</b> .....	1127
Gabriele Ferri	
<b>44 Social Interaction Design for Online Video and Television</b> .....	1157
Pablo Cesar and David Geerts	
<b>45 The Interactive TV Experience: Where We Came From and Where We Are Going</b> .....	1195
Michael J. Darnell	

---

<b>Part XI Social and Ethical Issues</b> .....	<b>1223</b>
<b>46 Addiction and Entertainment Products</b> .....	1225
Mark D. Griffiths and Halley M. Pontes	
<b>47 Applied Entertainment: Positive Uses of Entertainment Media</b> ...	1247
Jeffrey H. Goldstein	
<b>48 Introduction to the Ethics of New and Emerging Science and Technology</b> .....	1271
Tsjalling Swierstra	
<b>49 Negative Effects of Video Game Play</b> .....	1297
Christopher L. Groves and Craig A. Anderson	
<b>50 Unconscious Emotions in Media Content</b> .....	1323
Huang-Ming Chang, Leonid Ivonin, and Matthias Rauterberg	
<b>Index</b> .....	1353

---

## About the Editors



**Paolo Ciancarini** is Professor of Computer Science at the University of Bologna since 1992.

He got a Ph.D. in Informatics at the University of Pisa in 1988.

In Bologna, he lectures on Software Engineering and Software Architecture, and is member of the Faculty of the PhD School in Computer Science.

He currently is the President of the Italian Association of University Professors in Computer Science.

He is also the Vice-Director of CINI (National Inter-University Consortium for Informatics), a consortium of 43 universities engaged in national and international research projects.

In the period November 2011–June 2013, he has served in the national panel (ANVUR GEV01) for the evaluation of computer science research in Italian universities and research centers (VQR 2004–2010).

In the period March 2012–December 2013, he has been a member of the Italian ICT Delegation at the European Union for the 7th ICT Framework Program.

His research interests include: coordination languages and models, software architectures and infrastructures, advanced Web technologies, and software engineering for computer games.

He has been involved as a site leader in several projects funded by the European Commission and by the Italian Government.

He is the author of over 120 scientific papers and books.

He is married, has two children, and is a passionate chess player and book collector.



**Prof. Dr. Matthias Rauterberg** Eindhoven University of Technology (Netherlands), received a B.S. in Psychology (1978) at the University of Marburg (Germany), a B.A. in Philosophy (1981), a B.S. in Computer Science (1983), an M.S. in Psychology (1981), an M.S. in Computer Science (1986) at the University of Hamburg (Germany), and a Ph.D. in Computer Science/Mathematics (1995) at the University of Zurich (Switzerland). He was a senior lecturer for “usability engineering” in computer science and industrial engineering at the Swiss Federal Institute of Technology (ETH) in Zurich, where later he was heading the

Man-Machine Interaction research group (MMI) (1989–1998).

Since 1998, he is Fulltime Professor for “Interactive Systems Design” first at IPO – Centre for User System Interaction Research, and later at the Department of Industrial Design at the Eindhoven University of Technology (TU/e, The Netherlands). From 1999 till 2002, he was director of IPO. He was director of the graduate program at the Department of Industrial Design of the TU/e (2012–2014). He was the head of the Designed Intelligence research group (2006–2015). He was the Swiss representative in the IFIP TC13 on “Human Computer Interaction” (1994–2002) and the chairman of the IFIP WG13.1 on “HCI and Education” (1998–2004). He is now the Dutch representative in the IFIP TC14 on “Entertainment Computing” and the founding vice-chair of this TC14 (2006–2012). Since 2012, he is the IFIP TC14 chair (2013–2015). He was appointed as visiting professor at Kwansei Gakuin University (Japan) (2004–2007); he is senior honorary research fellow of Taicang University Science and Technology Park (since 2012) and guest professor at Jiangnan University (Wuxi, China) (2011–2015) and at East China University of Science and Technology (Shanghai, China) (2013–2016).

He received the German GI-HCI Award for the best Ph.D. in 1997 and the Swiss Technology Award for the BUILD-IT system in 1998. In 2004, he was nominated as member of the “Cream of Science” in the Netherlands (the 200 top-level Dutch researchers) and among the 10 top-level TU/e scientists. Since 2007, he is holder of the IFIP Silver Core Award.

He has over 400 publications in international journals, conference proceedings, books, etc. He acted also as editor and member of the editorial board of several leading international journals. Since 2009, he is co-editor-in-chief of the journal *Entertainment Computing* (Elsevier). He acts regularly as reviewer for national and international funding bodies, individual selection and departmental assessments committees, and large-scale European funding schemas. He was appointed as member of one of the few expert and evaluation panels for the most esteemed European grant from the European Research Council (2010–2014).



**Ryohei Nakatsu** received the B.S., M.S., and Ph.D. degrees in Electronic Engineering from Kyoto University in 1969, 1971, and 1982, respectively. After joining NTT in 1971, he mainly worked on speech recognition technology. In 1994, he joined ATR (Advanced Telecommunications Research Institute) as Director of ATR Media Integration and Communications Research Laboratories. In 2002, he became Professor at School of Science and Technology, Kwansai Gakuin University. Since March 2008 until December 2014, he was Professor

at National University of Singapore (NUS) and was Director of Interactive and Digital Media Institute (IDMI) at NUS. In December 2014, he retired from NUS and came back to Japan. Now he is Adjunct Professor of Kyoto University, Kyoto/Japan, and Visiting Professor of Seika University, Kyoto/Japan. Also he has established two start-up companies and now he is serving as CEO of Hexogon Japan and Executive Director of NT & Associates.

His research interests include interactive media, entertainment technologies, and communication robot/agent.

In 1978, he received Young Engineer Award from the Institute of Electronics, Information and Communication Engineers Japan (IEICE-J), in 1996 the best paper award from the IEEE International Conference on Multimedia, in 1999, 2000, and 2001, Telecom System Award from Telecommunication System Foundation and the best paper award from Virtual Reality Society of Japan, and in 2000 the best paper award from Japanese Society for Artificial Intelligence. Also he received in 2010 IEEE Kansai Section medal, in 2011 IEEE Virtual Reality Service Award, and in 2012 IFIP TC14 Contribution Award.

He is a fellow of the IEEE since 2001 and a life fellow since 2014. Also he is a fellow of the Institute of Electronics, Information and Communication Engineers Japan (IEICE-J) since 2001 and Virtual Reality Society of Japan since 2012. Also he is a honorary member of Japanese Society for Artificial Intelligence. He is a member of various academic societies such as IEEE, IEICE-J, Japanese Society for Artificial Intelligence, and others. He was a chair of IFIP Technical Committee on Entertainment Computing (TC14) since 2006 until 2012 and now is an honorary member of IFIP TC14.

---

## Contributors

**Nadjib Achir** L2TI – Institut Galilée, University Paris 13, Sorbone Paris Cité, Villetaneuse, France

**Craig A. Anderson** Center for the Study of Violence, Department of Psychology, Iowa State University, Ames, IA, USA

**Lynne Baillie** Department of Mathematical and Computer Science, Heriot-Watt University, Edinburgh, UK

**Francesco Bellotti** University of Genoa, Genoa, Italy

**Riccardo Berta** University of Genoa, Genoa, Italy

**Magdalena Bielenia-Grajewska** Intercultural Communication and Neurolinguistics Laboratory, Department of Translation Studies, Institute of English, Faculty of Languages, University of Gdansk, Gdańsk, Poland

**Yngvi Björnsson** School of Computer Science, Reykjavik University, Menntavegur, Reykjavík, Iceland

**Mayumi Bono** National Institute of Informatics, National Center of Sciences, Tokyo, Japan

**Khaled Boussetta** Urbanet, CITI Insa Lyon / INRIA Grenoble Rhône-Alpes, CITI lab, Villeurbanne, France

**Ulrich Brandstätter** Interface Culture, University of Art and Design Linz, Linz, Austria

**Armir Bujari** Department of Mathematics, University of Padua, Padua, Italy

**Aine Carroll** National Rehabilitation Hospital, Dun Laoghaire, Republic of Ireland

**Marc Cavazza** School of Electronics and Digital Arts, University of Kent, Canterbury, UK

**Pablo Cesar** CWI: Centrum Wiskunde and Informatica, Amsterdam, The Netherlands



**Huang-Ming Chang** Department of Industrial Design, Eindhoven University of Technology, Eindhoven, The Netherlands

**Fred Charles** School of Computing, Teesside University, Middlesbrough, UK

**Adrian David Cheok** Imagineering Institute, Nusajaya, Malaysia  
City University London, London, UK

**Chun-Hsiang Chuang** Brain Research Center, National Chiao Tung University, Hsinchu, Taiwan

**Damien Coyle** Intelligent Systems Research Centre, Ulster University, Derry, Northern Ireland, UK

**Michael J. Darnell** User Experience Center America – Visual Displays, Samsung Research America, Mountain View, CA, USA

**Alex Davies** Creative Robotics Lab, NIEA, UNSW Art and Design, Sydney, NSW, Australia

**Richard Davison** School of Computing Science, Newcastle University, Newcastle, UK

**Gabriele Ferri** School of Informatics and Computing, Indiana University, Bloomington, IN, USA

**Doron Friedman** The Advanced Reality Lab, The Interdisciplinary Center, Herzliya, Israel

**Elisabeth V. C. Friedrich** Department of Cognitive Science, University of California San Diego, La Jolla, CA, USA

**Marco Furini** University of Modena and Reggio Emilia, Modena, Italy

**Jhonatan Garcia** Intelligent Systems Research Centre, Ulster University, Derry, Northern Ireland, UK

**Xiaoyu Ge** Artificial Intelligence Group, Research School of Computer Science, The Australian National University, ANU College of Engineering and Computer Science, Canberra, Australia

**David Geerts** CUO, iMinds/KU Leuven, Leuven, Belgium

**Irini Giannopulu** Virtual Reality Prism, IHU-A-Brain and Spine Institute (ICM), UPMC, Groupe Hospitalier Pitié-Salpêtrière, Paris, France

**Jeffrey H. Goldstein** Institute for Cultural Inquiry, Utrecht University, Utrecht, The Netherlands

**Mark D. Griffiths** International Gaming Research Unit, Psychology Division, Nottingham Trent University, Nottingham, UK

**Christopher L. Groves** Center for the Study of Violence, Department of Psychology, Iowa State University, Ames, IA, USA

**Hayrettin Gurkok** Department EWI Research Group, Human Media Interaction (HMI), Faculty of Electrical Engineering, Mathematics and Computer Science, University of Twente, Enschede, The Netherlands

**Junichi Hoshino** Graduate School of Systems and Information Engineering, Entertainment Computing Laboratory, University of Tsukuba, Tsukuba-shi, Ibaraki, Japan

**Kiyoshi Hoshino** University of Tsukuba, Tsukuba, Ibaraki, Japan

**Hiroshi Ishiguro** Osaka University, Osaka, Japan

**Leonid Ivonin** Department of Industrial Design, Eindhoven University of Technology, Eindhoven, The Netherlands

**Arnav Jhala** University of California Santa Cruz, Santa Cruz, CA, USA

**Tzyy-Ping Jung** Swartz Center for Computational Neuroscience, University of California San Diego, San Diego, CA, USA

**Kasun Karunanayaka** Imagineering Institute, Nusajaya, Malaysia

**Stephan Keller** Knowledge Technologies Institute, Graz University of Technology, Graz, Austria

**Peter Khooshabeh** Cognitive Sciences Branch, U.S. Army Research Laboratory, Aberdeen Proving Ground, Aberdeen, MD, USA

**Akihiro Kishimoto** IBM Research, Ireland Research Lab, Dublin, Ireland

**Tatsuya Kitamura** Department of Intelligence and Informatics, Faculty of Intelligence and Informatics, Konan University, Kobe, Hyogo, Japan

**Noam Knoller** Interface Studies Group, Amsterdam School for Cultural Analysis (ASCA), University of Amsterdam, Amsterdam, The Netherlands

**Hartmut Koenitz** Department of Entertainment and Media Studies, University of Georgia, Athens, GA, USA

**Jeffrey Koh** Creative Robotics Lab, NIEA, UNSW Art and Design, Sydney, NSW, Australia

**Brent J. Lance** Translational Neuroscience Branch, U.S. Army Research Laboratory, Aberdeen Proving Ground, Aberdeen, MD, USA

**Anatole Lécuyer** INRIA, Centre de Recherche Rennes Bretagne-Atlantique, Campus de Beaulieu, Rennes Cedex, France

**Augustin Lefebvre** Sorbonne Nouvelle University Paris 3, Paris, France

**David Levy** Imagineering Institute, Nusajaya, Malaysia  
Retro Computers Ltd, Luton, UK

**Chen Li** Intelligent Systems Research Centre, Ulster University, Derry, Northern Ireland, UK

**Chin-Teng Lin** Brain Research Center, National Chiao Tung University, Hsinchu, Taiwan

**Fabien Lotte** INRIA, Centre de Recherche Bordeaux Sud-Ouest, Talence Cedex, France

**Guillaume Loup** LIUM, Université du Maine, Laval Cedex 9, France

**Emilie Loup-Escande** CRP-CPO (EA7273), Université de Picardie Jules Verne, Amiens, France

**Shao-Wei Lu** Brain Research Center, National Chiao Tung University, Hsinchu, Taiwan

**Dario Maggiorini** Department of Computer Science, University of Milan, Milan, Italy

**Perla Maiolino** Goldsmiths University of London, London, UK

**Amar Marathe** Translational Neuroscience Branch, U.S. Army Research Laboratory, Aberdeen Proving Ground, Aberdeen, MD, USA

**Alke Martens** Institute for Computer Science and Electrical Engineering, University of Rostock, Rostock, Germany

**Fulvio Mastrogiovanni** Department of Informatics, Bioengineering, Robotics, and Systems Engineering, University of Genoa, Genoa, Italy

**Rod McCall** Environmental Research and Innovation, Luxembourg Institute of Science and Technology, Esch-sur-Alzette, Luxembourg

**Karl. A. McCreddie** Intelligent Systems Research Centre, Ulster University, Derry, Northern Ireland, UK

**Kaleb McDowell** Translational Neuroscience Branch, U.S. Army Research Laboratory, Aberdeen Proving Ground, Aberdeen, MD, USA

**Jacinta McElligott** National Rehabilitation Hospital, Dun Laoghaire, Republic of Ireland

**Laurent Mignonneau** Interface Culture, University of Art and Design Linz, Linz, Austria

**Youichiro Miyake** Square Enix Co., Ltd., Tokyo, Japan

**Graham Morgan** School of Computing Science, Newcastle University, Newcastle, UK

**Hiroshi Mori** Graduate school of Engineering, Utsunomiya University, Utsunomiya-City, Tochigi, Japan

**Yukihiro Morisawa** Saitama Institute of Technology, Saitama, Japan

**Martin Mueller** University of Alberta, Edmonton, AB, Canada

**Wolfgang Müller** Media Education and Visualization Group (MEVIS), University of Education Weingarten, Weingarten, Germany

**Gernot Müller-Putz** Institute for Knowledge Discovery, Graz University of Technology, Graz, Austria

**Akiyo Nadamoto** Department of Intelligence and Informatics, Faculty of Intelligence and Informatics, Konan University, Kobe, Hyogo, Japan

**Ryohei Nakatsu** Design School, Kyoto University, Kyoto, Japan

**Anton Nijholt** Department EWI Research Group, Human Media Interaction (HMI), Faculty of Electrical Engineering, Mathematics and Computer Science, University of Twente, Enschede, The Netherlands

**Hiroki Nishino** NUS Graduate School for Integrative Sciences and Engineering, National University of Singapore and Graduate School of Media Design, Keio University, Singapore, Singapore

**Claudio E. Palazzi** Department of Mathematics, University of Padua, Padua, Italy

**Viktoria Pammer-Schindler** Know-Center GmbH, Graz, Austria

**Johanna Pirker** Institute of Information Systems and Computer Media, Graz University of Technology, Graz, Austria

**Mannes Poel** Department EWI Research Group, Human Media Interaction (HMI), Faculty of Electrical Engineering, Mathematics and Computer Science, University of Twente, Enschede, The Netherlands

**Halley M. Pontes** International Gaming Research Unit, Psychology Division, Nottingham Trent University, Nottingham, UK

**Julie Porteous** School of Computing, Teesside University, Middlesbrough, UK

**Christian Quadri** Department of Computer Science, University of Milan, Milan, Italy

**Siddharth Ramakrishnan** Neuroscience Program, Department of Biology, University of Puget Sound, Tacoma, WA, USA

**Matthias Rauterberg** Industrial Design, Eindhoven University of Technology, Eindhoven, The Netherlands

**Jochen Renz** Artificial Intelligence Group, Research School of Computer Science, The Australian National University, ANU College of Engineering and Computer Science, Canberra, Australia

**Mark Rice** Institute for Infocomm Research, A\*STAR, Singapore, Singapore

**Laura Anna Ripamonti** Department of Computer Science, University of Milan, Milan, Italy

**Elham Saadatian** School of Electronics and Computer Science, Interaction, Complexity Group, University of Southampton, Southampton, UK

**Paul Sajda** Department of Biomedical Engineering, Columbia University, New York, NY, USA

**Jose Saldana** Department of Electrical Engineering and Communications EINA, Aragon Institute of Engineering Research (I3A), University of Zaragoza, Zaragoza, Spain

**Hooman Samani** Department of Electrical Engineering, College of Electrical Engineering and Computer Science, National Taipei University, NTUP, Taipei, Taiwan

**Reinhold Scherer** Institute for Knowledge Discovery, Graz University of Technology, Graz, Austria

**Stephan Schiffel** School of Computer Science, Reykjavik University, Menntavegur, Reykjavik, Iceland

**Christa Sommerer** Interface Culture, University of Art and Design Linz, Linz, Austria

**Mark Springett** Middlesex University, London, UK

**Jacqueline Stow** National Rehabilitation Hospital, Dun Laoghaire, Republic of Ireland

**Mirko Suznjevic** Department of Telecommunications, Faculty of Electrical Engineering and Computing, University of Zagreb, Zagreb, Croatia

**Alistair D. Swale** Screen and Media Studies, School of Arts, Faculty of Arts and Social Sciences, University of Waikato, Hamilton, New Zealand

**Tsjalling Swierstra** Department of Philosophy, Faculty of Arts and Social Sciences, Maastricht University, Maastricht, MD, The Netherlands

**Naoko Tosa** Academic Center for Computing and Media Studies, Kyoto University, Kyoto, Japan

**Jon Touryan** Translational Neuroscience Branch, U.S. Army Research Laboratory, Aberdeen Proving Ground, Aberdeen, MD, USA

**Lars L. Tremper** Institute of Sport Science, Technische Universitaet Darmstadt, Darmstadt, Germany

**Tomohiro Umetani** Department of Intelligence and Informatics, Faculty of Intelligence and Informatics, Konan University, Kobe, Hyogo, Japan

**Gary Ushaw** School of Computing Science, Newcastle University, Newcastle, UK

---

**Erik van der Spek** Technische Universiteit Eindhoven, Eindhoven, The Netherlands

**Victoria Vesna** Department of Design Media Arts, Art | Sci Center, University of California Los Angeles, Los Angeles, CA, USA

Program in Empowerment Informatics, School of Integrative and Global Majors, University of Tsukuba, Tsukuba, Japan

**Yu-Kai Wang** Brain Research Center, National Chiao Tung University, Hsinchu, Taiwan

**Josef Wiemeyer** Institute of Sport Science, Technische Universitaet Darmstadt, Darmstadt, Germany

**Karin Wilding** Knowledge Technologies Institute, Graz University of Technology, Graz, Austria

**Mark H. M. Winands** Department of Data Science and Knowledge Engineering, Maastricht University, Maastricht, The Netherlands

**Thomas Winkler** University of Luebeck, Lübeck, Germany

**Wang Xuan** Rolls-Royce, Singapore, Singapore

**R. Michael Young** North Carolina State University, Raleigh, NC, USA